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CHEMISTRY.—*The addition compounds 3, 5-dibromo-o-toluidine with metallic salts.*[1] RAYMOND M. HANN and G. C. SPENCER. U. S. Department of Agriculture. (Communicated by EDGAR T. WHERRY.)

During a comparative study of two methods for the determination of nitrogen[2] it became a matter of interest to test the effect of metals upon the catalytic oxidation of organic matter by sulfuric acid previous to final conversion of all nitrogen to ammonium sulfate. The addition compounds of anilines with metallic halides seemed suitable for the study in mind, as they contained nitrogen and the desired metal in a single compound. Several such compounds were made. This paper reports the experimental data incidental to the preparation of addition products of 3, 5-dibromo-o-toluidine with mercuric chloride, zinc chloride, cadmium chloride, and cadmium bromide. The effect of the added metal upon the nitrogen determination was appreciable only in those cases where ammonia formed with the metal complex salts which were stable above the boiling point of water.

Addition compounds of aniline and its homologues with metallic salts are too well known to deserve comment.[3] Double salts of the hydrohalides of aniline and its homologues have been studied under the direction of Ira Remsen.[4] Few of the halogen-substituted anilines have been combined with metallic salts, except platinic chloride. Dibromo-o-toluidine combines readily with mercuric chloride, cad-

[1] Presented before the Ithaca meeting of the American Chemical Society, Sept. 8–13, 1924.

[2] Markley and Hann. Unpublished results.

[3] Beilstein, II: 312. 1896.

[4] Swann, Amer. Chem. Journ. **20**: 613. 1898; Slagle, *ibid.* 633; Base, *ibid.* 646; Higbee, *ibid.* 23: 150. 1900.

mium chloride, cadmium bromide, and zinc chloride in the ratio of two molecules of base to one molecule of metallic salt, yielding well-crystallized stable compounds.

EXPERIMENTAL

1-Methyl-3, 5-dibromoaniline.—This derivative was obtained by the method of Fuchs.[5] Thirty-three grams of o-toluidine was dissolved in 60 cc. of glacial acetic acid and an ice-cold solution of 100 grams of bromine in 180 cc. of glacial acetic acid was added gradually, with constant stirring, to the toluidine solution cooled in an ice bath. The hydrobromide separated immediately in white plates. Following addition of the bromine solution, an excess of water was added and, after standing for one hour in an ice chest, the precipitate separated. This was filtered by suction and dried. The yield was 107 grams. The base was readily released by suspending the crude hydrobromide in 200 cc. of cold 10 per cent sodium hydroxide. The yield of base was 67 grams. This melted at 45°C. without further purification.

3, 5-Dibromo-o-toluidine mercuric chloride 2:1.—Five grams of the dibromo-o-toluidine and 2.6 grams of mercuric chloride were dissolved in 50 cc. of 95 per cent alcohol. Following concentration to a volume of 10 cc. the solution was allowed to stand over night and the separated solid was then filtered off and recrystallized from alcohol. The compound separated in colorless needlelike crystals, 10 or more mm. long, rapidly changing in color to light red on standing. The yield was quantitative. When heated in a capillary tube the compound began to darken at 80°C. and melted, although not sharply, at 120°C.

Analysis: 0.2748 g. substance consumed 607 cc. of 0.1 N acid equivalent to 3.41 per cent N. Theory for $2C_7H_7N\,Br_2 \cdot HgCl_2$ = 3.49 per cent N.

3, 5-Dibromo-o-toluidine zinc chloride 2:1.—This derivative separated from an alcoholic solution containing 5 grams of base and 1:3 grams of metallic halide upon concentrating to a volume of 10 cc. and cooling in an ice-bath. The solid was filtered off by suction, washed with ice-cold alcohol, and dried. It was obtained as a slightly red, microcrystalline powder. It melted at 211°C., following a color change at 200°C. Corresponding compounds of aniline and the toluidines have been prepared by Tombeck.[6]

[5] Fuchs, Monats. **36**: 113. 1915.

[6] Tombeck, Comptes Rendues **124**: 1531. 1897.

Analysis: 0.3325 g. substance consumed 10.1 cc. of 0.1 N acid equivalent to 4.25 per cent N. Theory for $2C_7H_7N\,Br_2 \cdot ZnCl_2$ = 4.20 per cent N.

3, 5-Dibromo-o-toluidine cadmium bromide 2:1.—Two and five-tenths grams of cadmium bromide and 5 grams of the substituted toluidine were dissolved in 50 cc. of alcohol and refluxed for several hours on the steam bath. Upon cooling, the addition compound separated in white velvety needles. The substance was recrystallized from alcohol. It did not melt below 225°C.

Analysis: 0.1290 gram substance consumed 3.1 cc. of 0.1 N HCl equivalent to 3.36 per cent N. Theory for $2C_7H_7N\,Br_2 \cdot Cd\,Br_2$ = 3.49 per cent N.

3, 5-Dibromo-o-toluidine cadmium chloride 2:1.—This double salt was prepared by the general procedure previously outlined. It was obtained as a colorless microcrystalline powder, quite soluble in cold alcohol, and rapidly assumed a red color upon exposure to light and air. It did not melt below 200°C.

Analysis: 0.1484 gram substance consumed 4.2 cc. of 0.1 N acid equivalent to 3.96 per cent N. Theory for $2C_7H_7N\,Br_2 \cdot Cd\,Cl_2$ = 3.92 per cent N.

SUMMARY

3, 5-Dibromo-o-toluidine combines with metallic halides to give addition compounds containing two molecules of base to one molecule of metallic salt.

The mercuric chloride, zinc chloride, cadmium bromide, and cadmium chloride 2:1 addition compounds have been prepared and analyzed.

The presence of the metals did not adversely affect the nitrogen results as determined by the official method.

BOTANY.—*The value of certain anatomical characters in classifying the Hibisceae.* FREDERICK L. LEWTON, U. S. National Museum.

The classification of genera and species of the Mallow family bearing capsular fruits, which are usually considered as comprising the tribe Hibisceae, has presented more or less difficulty to workers in systematic botany when preparing formal descriptions, tables of relationships, and keys.

The writer believes that the difficulties met with largely result from the choice of certain variable and inconstant anatomical characters

which heretofore have been believed to be of prime importance in distinguishing between genera and species.

Dr. Otto Kuntze in 1891 called attention to the fact that the genera of the Hibisceae are poorly separated, and stated as follows[1]: "I know of no single character in *Gossypium* which one may not also find in *Hibiscus*." He then proceeded to add to the already bulky and overloaded genus *Hibiscus* all the species of the genera *Gossypium*, *Fugosia*, *Sturtia*, *Thurberia*, and *Thespesia*.

An examination of the principal standard systematic works shows that the anatomical characters which have been considered of most value and most frequently used by authors in describing the several genera of the tribe Hibisceae, and to some extent their species also, are the following: (1) The numerical divisions of the style and ovary; (2) the length of the style branches; (3) the shape and size of the involucral bracts; (4) the number of nectaries on the underside of the leaves; (5) the presence or absence of petal spots; (6) the covering of seed.

None of the characters mentioned are constant or exclusive for a single one of the genera heretofore included in the tribe, and in delimiting the genera of this group other descriptive characters must be sought for.

ANATOMICAL CHARACTERS WHICH ARE OF LITTLE VALUE OR WHICH HAVE BEEN MISUSED

An examination of the use in the principal systematic works of the commonly accepted descriptive characters listed above will show the cause of much of the confusion and difficulty in the classification of these plants, and bears evidence of the dependence placed on these anatomical distinctions by a number of well-known systematic writers.

1. *Numerical divisions of the style and ovary.*—With the possible exception of the genus *Hibiscus*, the divisions of the ovary vary from 3 to 5 in practically all the genera which have been placed in the Hibisceae, and in some genera almost every plant, when examined, may be found to bear capsules having 3, 4, or 5 cells. In spite of the variableness in the number of cells of the ovary, many authors use a definite number in the sense of a descriptive character in limiting genera and preparing analytical keys. Bentham and Hooker[2] state that *Fugosia* (*Cienfuegosia*) has 3 to 4-celled capsules and *Gossypium*, 5-celled. Whereas there are several species of *Fugosia* which commonly have 5-celled capsules and only the highly selected and well

[1] KUNTZE, Rev. Gen. Pl. 1: 67. 1891.
[2] BENTHAM & HOOKER, Gen. Pl. 1: 209.

cultivated varieties of *Gossypium* have a large percentage of 5-celled fruits. K. Schumann, in his key to the Hibisceae, states[3]:

"Ovary 5-celled..... *Gossypium;*
Ovary 3-celled..... *Ingenhouzia;*
Capsule consisting of 5 carpels..... *Thespesia;*
Capsules mostly consisting of 3 carpels..... *Cienfuegosia.*"

Garcke[4] states that one will as soon find a 5-celled *Cienfuegosia* as a 3-celled *Hibiscus*, yet *Cienfuegosia drummondii* was described by Dr. Gray as having a 5-celled, rarely a 4-celled, capsule. Saint-Hilaire nearly 100 years ago noted how little dependence could be placed upon the numerical division of the ovary. He said[5]: "If the genus *Hibiscus* did not contain already such a large number of species we would not hesitate to include in it the genus *Fugosia* because a careful comparison gives as a definite result only one difference of little importance; that of the number of the stigmas and of the cells. Also among the species of *Gossypium*, which have so many affinities with *Hibiscus* and *Fugosia*, we see these same parts presenting indifferently the numbers 3 or 5."

2. *Length of the style branches.*—The descriptive terms most often used in separating the genera *Hibiscus*, *Cienfuegosia*, and *Gossypium* are "Style branches long," and "Style simple, clavate or parted into short erect branches." In many of these plants, depending upon the age of the flower, the divisions of the style may be spreading, or erect and connivent, and appearing as if clavate. This was one of the reasons given by Saint-Hilaire for not recognizing Ventenat's genus *Redoutea*. Moreover the length of the style branches varies, and it is often difficult to decide between "long" and "short." Most systematic works still recognize under the genus *Hibiscus* species having a simple, clavate style.

3. *Shape and size of involucral bracts.*—In the cultivated cottons the shape and size of the involucral bracts are almost as variable as the leaves, and in the published species of *Cienfuegosia* the bracts vary from none to 12 or 15, and in form from a few bristle-like hairs to large cordate or toothed bracts. Still, the number, shape, and size of the involucral bracts are used by Bentham and Hooker,[2] and by Schumann[3] in their analytical keys to separate closely related genera belonging to this group. Hochreutiner,[6] who has given much study to this group of the Malvaceae, assigns *Gossypium sturtii* F. v. M. to the genus *Cienfuegosia* because of its entire involucral bracts even though it otherwise has the habit of *Gossypium;* and Prof. G. E. Mattei[7] of the Botanic Garden at Palermo, quotes Hochreutiner as ascribing to the genus *Cienfuegosia* all species of *Gossypium* having entire, instead of

[3] SCHUMANN, K., in Engler & Prantl, Nat. Pflanzenf. 3[6].
[4] GARCKE, Bonplandia 8: 150. 1860.
[5] SAINT-HILAIRE, Fl. Bras. Merid. 1: 251–252. 1825.
[6] HOCHREUTINER, B. P. G., Ann. Conserv. Jard. Bot. Genève 6: 56. 1902.
[7] MATTEI, G. E., Boll. Real Giar. Col. Palermo 1: 224. 1914.

laciniate, involucral bracts. Ulbrich, remarking on a Mexican plant which he makes the type of his genus *Selera*, says[8]: "This plant resembles a species of *Gossypium;* it possesses, however, an involucre of entire, ovate, cordate bracts and seeds so slightly hairy that it can not be included in that genus."

4. *Number of leaf nectaries.*—The older descriptions of species of *Gossypium* always gave the number of nectaries to be found on the veins of the lower side of the leaves. The species *Gossypium eglandulosum* Cav. was considered distinct from other cottons because no nectaries were found on the leaves. The number of these glands on the leaves of any one plant or species usually depends upon the number of lobes of the leaf and whether the leaf is situated on a branch or on the main stem. The uselessness of the number of nectaries on the leaf as a varietal or specific character was long ago pointed out by Von Rohr[9] and Medicus.[10] Leake,[11] working with certain Indian species, notes the varying number of leaf nectaries, and states that it is possible to recognize forms within the species in which the leaves are all eglandular. *Gossypium tomentosum* Nutt., a native Hawaiian species, is without any nectaries on its leaves, as is also a cultivated Indian variety of *Gossypium nanking* Meyen, grown by the writer out of a row of 130 plants of which but one plant bearing leaf nectaries was produced.

5. *Petal spots.*—Practically all of the species of this tribe which have never been cultivated bear a pink, crimson, or purple spot on the base of each petal. On the other hand a great many cultivated varieties of cotton have lost the petal spot, though in certain varieties it sometimes reappears in a few individuals. An example of this is found in the early Upland variety known as "King." In the cultivated species in which it normally occurs, such as Sea Island, Egyptian, and Kidney cottons (*G. barbadense* and *G. lapideum*), it is often quite variable in size and distinctness.

6. *Covering of the seed.*—Several writers, notably Von Rohr,[9] Rafinesque,[12] and Watt,[13] have attempted a classification of varieties and species of *Gossypium* based entirely upon the covering of the seed. The seeds of a few of the genera of the Hibisceae are devoid of a downy or fuzzy covering, but in most of the genera the wild species have their seeds covered with rusty down or fuzz. In the cultivated varieties of cottons, however, the color and amount of the fibrous covering is so variable within the species, and even within the variety, as to make this character of doubtful value in taxonomic work. Certain degenerate types of the common Upland fuzzy-seeded cotton not only have naked seeds but the bolls contain little or no lint.

[8] ULBRICH, E., Verhandl. Bot. Ver. Brandenburg **55**: 168. 1913.
[9] VON ROHR, J. P. B., Anmerkungen über den Cattunbau part 2. 1793.
[10] MEDICUS, F. K., Bot. Beob. **2**: 201. 1783.
[11] LEAKE, H. M., Journ. Genetics **1**: 239. 1911.
[12] RAFINESQUE, C. S., Sylv. Tellur. 14–19. 1838.
[13] WATT, GEO., *The wild and cultivated cotton plants of the world*, pp. 8, 56, 60. 1907.

A wild cotton found growing on the coast of Jamaica by Britton and Harris has both smooth and fuzzy-seeded forms growing side by side, a condition which is also found in certain Chinese and Transcaucasian forms of *Gossypium nanking*. Yet Watt does not hesitate to use the presence or absence of fuzz on the seed as a basis of classification of species, and believes the differences in the covering of the seed to be "almost sub-generic in value."[13] H. M. Leake[14] has called attention to this "new character" in Asiatic cottons. W. L. Balls gives his opinion of the dependence to be placed in the covering of the seed as a taxonomic character thus[15]: "Similarly the smoothness or 'fuzziness' of the seed, which has been ridden to death in some schemes of classification, is almost an accident; various forms of the accidental result happen to be commoner in some species than others, but the naked-seeded forms are known now in all the commercial cottons, having probably arisen as sudden sports."

ANATOMICAL CHARACTERS WHICH ARE OF VALUE IN CLASSIFYING THE HIBISCEAE

In place of the variable anatomical characters mentioned above, some of which are of taxonomic value when their limitations are known, other characters are here suggested which are believed to be more dependable for systematic classification. These may be listed as follows:

1. The extra-floral nectaries (excluding those on the leaves); position, number, shape, and size.
2. Black oil glands; presence or entire absence, distribution.
3. Fringe of hairs on valves of carpels.
4. Persistence of involucral bracts.
5. Adnation of bracts to each other.
6. Number of chromosomes.

A few examples of the use already made of these anatomical characters by systematists are offered in the paragraphs below, and practical application of them to the problem of classifying the already established genera and species of the Hibisceae is promised in further studies in this series.

1. *Extra-floral nectaries.*—The various species of *Gossypium* and related genera are usually provided with one or two sets of extra-floral nectaries in addition to the one or more nectaries usually found on the underside of the leaves.

In Professor Comstock's exhaustive study of cotton insects, Dr. William Trelease describes[16] the nectar secreted by the cotton plant and discusses its value in attracting certain insects which might aid in cross-pollination or act as guardians against the ravages of other insects.

[14] LEAKE, H. M., *Observations on certain extra-Indian Asiatic cottons.* Mem. Dept. Agr. India Bot. **4**: (5): 111. 1912.

[15] BALLS, W. L., *The development and properties of raw cotton.* 3. 1915.

[16] TRELEASE, W. in Comstock, J. H., *Report upon cotton insects.* U. S. Dept. Agr., 317–343. 1879.

Where these extra-floral nectaries have been mentioned by systematic botanists at all, they have usually been spoken of as "glands" without clearly distinguishing them from the floral nectary proper or from the black oil-glands to be seen so prominently in nearly all parts of the plant. But little attention to the extra-floral nectaries has been given by taxonomists, and their value as diagnostic characters in formal descriptions and keys has generally been overlooked.

Tyler has clearly drawn[17] the distinction between the four types of nectaries, and has indicated their value in the classification of the cottons and their nearest relatives. Stanford and Viehoever describe[18] the nectaries, and show that they differ morphologically from the internal black glands and have no connection with them.

2. *The black oil-glands.*—The chemistry of the black oil-glands, black dots, or internal glands, as they are called by various authors, which are found in all parts of the cotton plant, has been studied by Stanford and Viehoever,[18] who state that they have been noted within the Malvaceae only in certain genera of the subfamily Hibisceae, and that other genera appear not to possess glands of this type. The absence of these black internal glands from the cotyledons of the five species of Australian plants, placed by Fr. von Mueller first in the genus *Gossypium* and later *Fugosia* (*Cienfuegosia*), was noted by Todaro in his *Monograph of Gossypium*[19] and used by him to separate subgenera. The distribution and arrangement of these glands was noted by Cavanilles in characterizing his genus *Cienfuegosia*.[20]

3. *Fringe of hairs on the valves of the carpels.*—The most prominent character of the genus *Thurberia* as described by Gray[21] is a false dissepiment in each cell of the ovary which, upon the maturing of the capsule, breaks up into a fringe of long silky hairs along the edges of the carpels. These hairs seem to have a part in the ejection of seed from the open valves of the capsule in a manner somewhat analogous to the peristome on the capsule of certain mosses. Similar carpellary fringes are to be found on *Cienfuegosia heterophylla* (Vent.) Garcke, of southern Florida and the West Indies, *Cienfuegosia yucatanensis* Millsp., of Yucatan, *Gossypium harknessii* Brandegee, of Lower California, *Erioxylum palmeri* Rose, of Mexico, and numerous other species included in genera other than *Thurberia*. The edges of the carpels of the capsules of *Lagunaria patersoni*, a handsome ornamental

[17] TYLER, F. J., *The nectaries of cotton.* U. S. Dept. Agr. B. P. I. Bull. 131, pt. 5. 1908.

[18] STANFORD, E. E. & VIEHOEVER, A., *Chemistry and histology of the glands of the cotton plant, with notes on the occurrence of similar glands in related plants.* Journ. Agr. Research **13**: 419–435, *pl.* 42–50. May 20, 1918.

[19] TODARO, A., *Relazione sulla cultura dei cotoni in Italia* 98. 1878.

[20] CAVANILLES, A. J., Monad. Diss., Decem. 174, *pl. 72, f. 2.* 1786.

[21] GRAY, A., Pl. Wright. 1: 23. 1852.

Australian tree, are provided with a thick fringe of very fine, stiff, golden, deciduous hairs pointing inwards and retarding the dissemination of the smooth seeds. Dr. E. W. Bick, Curator of the Brisbane Botanic Garden, Queensland, describes these as follows[22]: "Attached to the inner portion of the capsules are numerous short barbed hairs that will attach themselves to the skin, and are very irritating, being not unlike those of the velvet bean, *Mucuna pruriens*, commonly called cow-itch."

4. *The persistence of the involucral bracts.*—The deciduous nature of the involucral bracts of the so-called Australian cottons (*Notoxylinon*) and of species of the genera *Thespesia* and *Montezuma* has been made use of by several authors in formulating generic distinctions and analytical keys.

5. *The adnation of the involucral bracts to each other.*—Whether the bracteoles forming the involucre are free from each other or more or less united at their bases is a factor considered by Sir George Watt to be of value in the classification of cottons. His words are as follows[23]: "The most instructive characteristics are derived from the position and condition of the bracteoles; the presence or absence of nectar-yielding glands; and the nature of the floss and fuzz that surround the seed." However, this writer finally gives first place to the covering of the seed as a diagnostic character, the adnation of the bracteoles being stated as the second most important character in defining his sections of *Gossypium*.[24] Hochreutiner,[25] in his revision of the genus *Hibiscus*, considers this character of importance in classifying the large number of species belonging to that genus.

The adnation of the involucral bracts of certain tropical American cottons and species of the Old World has been suggested by O. F. Cook[26] as having a protective value, but he does not suggest its use for purposes of classification.

6. *Number of chromosomes.*—During the past year three investigators, H. J. Denham in England,[27] A. G. Nikolajeva in Russia,[28] and A. E. Longley in Washington, have studied, independently of each other, the chromosome numbers of different species of cottons and some related genera. Each of these investigators has pointed out that the species so far studied fall into two groups, one having 13 chromosomes and the other 26. These two groups have already been well defined as the Old World and the New World cottons.

[22] BICK, E. W., *Flowering trees of the Brisbane Botanic Garden.* Agr. Journ. Queensland **16**: 379–380. 1921.

[23] WATT, GEO., *loc. cit.* p. 60.

[24] WATT, GEO., *loc. cit.* pp. 61, 77, 163, 244, 316.

[25] HOCHREUTINER, B. P. G., *loc cit.* **4**: 23–191. 1900.

[26] COOK, O. F., *The weevil-resisting adaptations of the cotton plant.* U. S. Dept. Agr. B. P. I. Bull. **88**: 31, 32, 37. 1906.

[27] DENHAM, H. J., *Chromosome numbers of Old and New World cottons.* Ann. Bot. **38**: 433–438. July, 1924. Journ. Textile Inst. Manchester **15**: T1496–1500. Oct., 1924.

[28] ZAITEV, G. S., Bull. Applied Bot. & Pl. Breeding (Russian) **13**: 132. 1924.

Cytological studies of this kind have opened a new field of investigation which is sure to throw much light on the relationships of the important economic plants.

ENTOMOLOGY.—*The wasp* Nysson hoplisivora, *a parasitic relative of* Hoplisus costalis. EDWARD G. REINHARD, Canisius College, Buffalo, New York. (Communicated by S. A. ROHWER.)

It has been customary to extoll the solitary wasps as examples of altruism and industry. They are the industrious fossores, considered to be of a superior race above the ruder parasitic Hymenoptera. So they are, a very respectable clan, yet, like many noted families, they are not without a "black sheep" to stain the family honor. It was only recently that any wayward habits among the members of the Sphecoids have been brought to light. But information is accumulating, and the evidence points to a degenerate branch, the *Nyssonini*, as a set of parasites who revel in robbery and fratricide.

The *Nyssonini* had a clear record for centuries because no one had ever investigated their manner of life. In 1887 Handlirsch voiced the first suspicion by noting how similar in appearance some of them were to the species of bees who practised parasitism. Yet nothing definite was known about the life-history of any Nysson until 1901 when Ferton observed the behavior of *Nysson dimidiatus* in France, and found indications of parasitic habits.

Dr. William M. Wheeler, writing in 1919, thus summarizes the knowledge of Nysson's habits: "According to Ferton (1901) the Gorytid *Nysson dimidiatus* is a parasite of *Gorytes elegans*. The latter digs its burrow in the sand and provisions it with larval and adult Hemiptera; the Nysson finds it and often enters it during the absence of Gorytes. If the latter happens to be at home the Nysson waits motionless about a dozen centimeters away, with its head turned towards the nest, till the Gorytes departs. Adlerz (1910) observed very similar behavior on the part of *Nysson maculatus* towards *Gorytes lunatus*. Apparently both species of Nysson destroy the Gorytes egg attached to the prey and lay their own in its place."[1]

Neither Ferton nor Adlerz succeeded in finding the Nysson's egg or larva or any signs of parasitic depredations beyond the suspicious actions of the wasp and its forceful entry into the Gorytes' burrow. Barth in 1907 had made additional observations of which Dr. Wheeler was not aware. He saw in Wisconsin a *Nysson fidelis* (Cres.) rapidly

[1] *The parasitic Aculeata, a study in evolution.* Proc. Amer. Phil. Soc. **58**: no. 1: 15.

scratch open and enter the nest of an absent *Gorytes canaliculatus*. The Nysson remained within for several minutes, then came out again and closed the entrance. The following day when the nest was opened, one of the cells was found to contain nine tree-hoppers and two eggs. One egg was glued to the thorax of a hopper, another smaller one was found lying unattached on the floor of the cell. This smaller egg, evidently that of Nysson, was in shape similar to the Gorytes' egg, but its surface was less shining.

These three observations seem to be the only evidence recorded in entomological literature of the singular manner of life practised by the Nysson wasps.

During the summer of 1922 while investigating the habits of *Hoplisus costalis* at Woodstock, Maryland, I made the acquaintance of an interesting Nysson previously unknown to science, which S. A. Rohwer described[2] as *Nysson* (*Brachystegus*) *hoplisivora*. An account of the habits of this wasp will furnish us with new material for a consideration of Nysson's parasitic behavior. The Nysson parasitoids are especially noteworthy because in all these cases the parasite bears a very close genetic relationship to its host, and according to the evolutionary doctrine it is supposed in general to have sprung from the same stock as its host species.

The host of *Nysson hoplisivora*, as well as its parasite, both belong to the subfamily Nyssoninae. It is a wasp sometimes known as *Gorytes costalis*, though *Hoplisus costalis* is now the approved form. It preys upon various species of tree-hoppers (Membracidae) which it stores away in burrows dug into the sandy earth. Five or six membracids are commonly placed in a single cell and the wasp's egg is deposited on the last one brought in, along the lateral edge of the bug's broad sternum. The mouth of the burrow is kept barricaded with a loose covering of sand which the wasp scrapes away when entering and carefully replaces when about to depart.

There were about twenty nests of *H. costalis* sunk into the sand of a brick-covered path which was the site of a thriving settlement of the solitary wasps *Philanthus gibbosus*, who capture wild bees of the family Halictidae. Both wasps build nest-mounds of about the same size, those of Philanthus being somewhat more spreading.

Somewhere among these nests, flying about, or resting in the neighborhood of a burrow, could always be found two or three of the Nysson wasps. They were small but very neat-appearing in their dress of dull

[2] Proc. Ent. Soc. Washington **25**: no. 4. April, 1923.

black and the first abdominal segment gleaming with red and yellow, like a ripe apple. They would fly very low, just skimming over the surface, to pause at every sand heap, inspect it, circle about inquisitively, and dart along to the next mound. The burrows of Philanthus did not interest them. They delayed longest at the doors of Hoplisus to gather information with trembling taps of their antennae. If the owner was about, the visitor would sometimes settle herself on the ground close by, and, with watchful gaze directed at the doorway, wait quietly until Hoplisus had departed. At times she would enter an open gallery but come out hastily again, and warily take up a post of observation to sit awaiting. But when the coast was clear and the nest vacated, the Nysson would boldly break through its barricaded portal to enter the nurse-chambers below, where her depredations could be committed without detection.

For several days the lurking Nyssons haunted the colony before I could succeed in witnessing with full convicting evidence their sneaky methods. On July 12, early in the morning, I am watching near a clump of burrows which the Hoplisi has excavated. The tenent of the nearest dwelling has already gone off on her hunting expedition. A prying Nysson appears in the offing. She skims over to the unguarded nest and alights on the little plateau of sand. Just a slight bit of hesitation and inspection, then the Nysson commences to tear away at the loose sand with her front tarsal rakes. She does her work audaciously and quickly. In a moment the tunnel is exposed and the Nysson slips swiftly within. Only a few seconds does she tarry. Then the intruder emerges and with wonderful nonchalance, as it were, carefully rearranges the sand over the doorway. To see her you would think she was the dwelling's rightful owner and housewife. When the tunnel is once more blocked and the nest entrance obliterated, the Nysson calmly departs.

Was the Nysson's action in closing the burrow really an attempt to eliminate the traces of her forced entrance, or was it merely a tropism and remnant of the days when her more industrious ancestors were wont to throw a curtain of sand over the doorway at every departure?

In less than ten minutes, Hoplisus appears on the scene, she whose home had been invaded. Under her body she carries a motionless membracid. Will the wasp notice anything amiss in the arrangement of her doorway or in the sacred chambers below? The wasp proceeds as usual. She gives no evidence of alarm. The burrow is entered, her fresh capture left in the nest, and the busy matron ventures forth

again to resume her quest after choice tree-hoppers for her own—no, quite unwittingly now for another's offspring.

After an hour's hunt, Hoplisus returns a second time with a captive, and thus for three hours longer I leave her to perform her hunting and household duties unmolested. At length, I begin to open the invaded burrow to see what rape or ruin the despoiler has accomplished. The corridor sloped gently downward for six inches, at the terminus of which was a single oval cell. A branch gallery led off further, but only this first cell had been provisioned. It contained six Ceresae piled two deep in a double layer. A Ceresa in the upper layer bore the Hoplisus egg. A Ceresa in the lower layer bore the parasite's egg. This was so skillfully concealed and protected as to claim my astonishment. The Nysson had inserted it under the folded wings of the tree-hopper where it rested hidden and secure along the bug's dorsal abdomen. Repeatedly have I discovered the egg of *hoplisivora* in the cells of Hoplisus and it is always found tucked away in the same position.

Let us compare host egg and parasite egg. The former is more than twice as large as the latter. Hoplisus lays an egg which is bow-shaped, 3 mm. long, smooth, shining white, and glued by its caudal pole to the sternum of the tree-hopper alongside the hind coxa. It arches forward along the body to the hopper's head. The parasite, *Nysson hoplisivora*, deposits an egg which is fairly straight and cylindrical, 1.34 mm. long, its greatest width 0.44 mm. The shell is dull white, tough, with a "goose-flesh" texture that shows under the microscope as numerous small excrescences placed with regularity.

For one reason or another I could not succeed in tracing out the entire history of the parasite from a single individual, but, having gathered scraps of information here and there, and having pieced them together, the remainder of the story became apparent. Some scattered bits of data taken from my note-book are here placed in order:

1. (July 13, cell no. 1). This cell contained five Membracids. The Nysson egg was tucked away under the wings of a *Platycotis vittata*. There was no Hoplisus egg present in the cell.

2. (July 12). Six membracids in the cell. The Nysson egg and the Hoplisus egg, each on separate bugs.

3. (July 20). Cell contained six membracids, the Nysson egg, and the Hoplisus egg. The following day, 7.30 a.m., the egg of the parasite hatched. Twelve hours later the egg of the Hoplisus hatched.

4. (July 15, cell no. 1). Six membracids. The Hoplisus egg is near hatching; the egg of the parasite has hatched. The larva feeds for a short time, then leaves its hopper to go exploring.

5. (July 13, cell no. 4). Five membracids. The Hoplisus egg near hatching. To its basal end is attached a small larva half as long as the egg.

6. (July 15, cell no. 2). Five membracids. The parasite larva has just finished eating the Hoplisus egg and is attacking the hopper under the hind femur. The parasite feeds facing the opposite from the direction in which the Hoplisus larva is turned when beginning its meal.

From these data it is quite easy to construct the story of the Nysson's depredations:

Nysson hoplisivora manages to install her egg in the nest-chamber of Hoplisus previous to the oviposition of the host-wasp who does not place her egg in the cell until the full quota of Membracids has been gathered. The parasitic egg hatches half a day in advance of the Hoplisus egg. The intruding larva takes a little nourishment, then advances through the cell to seek out and devour the egg of its host. When its rival is destroyed, *hoplisivora* feasts without danger of molestation upon the store of provisions which its parasitism has appropriated.

These facts do not agree with the previous opinion of entomologists that the Nysson destroys the egg of the Hoplisus wasp in order to lay its own in place of the host egg, for in reality the destruction of the host egg is performed by the parasitic larva and not by its mother. This incorrect surmise led Dr. Wheeler to discuss a "Nysson type of Parasitism" which seemed singular and perturbing because it was without a corresponding type among the parasitic bees. The case of Nysson however is quite parallel in its general scheme with that of Stelis among the bees.

When the egg of the parasite wasp has hatched the infant larva may be seen moving about in the space between the wings and body of the treehopper. For the first few hours it attacks the flanks of the bug and secures a little liquid nourishment. Then, aroused by some inexplicable urge it leaves its feast and goes exploring through the cell. When it starts on its trip of adventure the larva is a short, stout grub with a large head. It bears on its under surface some queer blisters, which are possibly leg-like appendages that render assistance in crawling. From its mouth projects a pair of long, thin mandibles, sharp and curved like the venom-fangs of a rattlesnake.

The restless larva moves about over the heap of food. Sooner or later it comes in contact with the frail Hoplisus egg, pregnant with the developing form of another larva, larger than the parasite, and capable of becoming a powerful rival. The jaws of the adventurer

open wide; the instinct for slaughter is aroused; its sharp fangs close upon the living egg; they rend and tear it, while the hoplisivorous son of Nysson proceeds to devour Hoplisus and by its cannabalism becomes sole possessor of the chamber of food.

The remainder of the story is quickly told. The spoils gained by slaughter are soon consumed. A series of moults transforms the usurper from a small larva with sharp, falcate jaws and belly-blisters, to a common grub with broad, blunt, bidentate mandibles, round of abdomen without ambulatory contrivances. When the parasite has eaten its fill, it sets about constructing a cocoon of brown silk and earth, and thus once again betrays its Hoplisoid ancestry, for the cocoon of *Nysson hoplisivora* is indistinguishable from that of *Hoplisus costalis* except by its slightly smaller size.

ENTOMOLOGY.—*Five braconid parasites of the genus* Heterospilus. S. A. ROHWER, Bureau of Entomology, U. S. Department of Agriculture.

The five new species described below have been received at various times for identification, and the senders are anxious to have names for them so that they can use them in connection with papers dealing with the biology of their hosts. These species add considerably to our knowledge of the habits of the representatives of this genus.

Heterospilus beameri, new species

Female.—Length, 2.75 mm. Frons immediately above the antennae finely aciculate; vertex and posterior orbits shining, practically without sculpture; antenna 23-jointed; scutum and prescutum rather coarsely granular, the prescutum more finely so anteriorly, the median posterior area of the scutum reticulate in addition to the granulations; notauli feebly foveolate anteriorly; the depression in front of the scutellum narrow, without longitudinal rugae; scutellum subopaque, finely tessellated; dorsal carinae of the propodeum well defined but narrow, the lateral-basal areas finely granular; the posterior face of the propodeum not sharply separated from the dorsal aspect, rather finely reticulate, without lateral carinae but with two rather indistinct median carinae which converge below; mesepisternum above the sulcus coarsely granular, below the sulcus tessellated; first tergite granular with two median carinae which bound the raised area and converge posteriorly; second tergite with a U-shaped suture basally and with triangular basal lateral areas defined by sutures, the surface granular except the apical margin; base of the third and fourth tergites feebly punctured, the punctures more widely separated on the fourth; ovipositor subequal in length to the abdomen; second abscissa of radius slightly shorter than the first; stigma angulate at the middle where the radius leaves it. Piceous; the second and fifth joints of antennae and legs below coxae, except last joint of tarsi which is blackish, stramineous; wings hyaline, iridescent, venation pale brown.

Male.—Length, 2.75 mm. The male agrees in sculpture very well with the female except that the first tergite is longitudinally striate in addition to the granulations, the base of the second tergite is longitudinally wrinkled, and the U-shaped area of the second tergite is greatly lengthened so it is almost a truncate V. The third and following tergites are more distinctly sculptured than in the female; the posterior femora are short, robust and broad at the base; antenna 24-jointed; the carinae on the dorsal aspect of the propodeum are feeble; posterior wings without a stigma.

Paratype females indicate variation in the number of antennal joints. In some of them they are 22- and in others they are 25-jointed. Paratype males indicate that the antennae may have only 22 joints. Some male paratypes are only 2 mm. long.

Type locality.—Cherokee County, Kansas.

Described from eleven females (one type) and seventeen males (one allotype) collected June, 1924, by R. H. Beamer, for whom the species is named. In submitting this material Mr. Beamer writes, "They were reared from the eggs of *Cicada.*"

Type, allotype and twelve paratypes.—Cat. no. 23973, U. S. N. M. Five female and nine male paratypes returned to the Entomological Collections of the University of Kansas.

This species falls nearest to *languriae* Ashmead, but is readily distinguished from it by the sculpture of the second tergite. The male is one of the unusual forms of the genus, inasmuch as the stigma of the hind wing is wanting.

Heterospilus cephi, new species

Female.—Length, 2.25 mm. Length of ovipositor, 0.5 mm. Head behind the ocelli finely, transversely striate; antenna 27-jointed, the joints poorly differentiated; pronotum not dentate laterally; scutum and prescutum rather coarsely granular; notauli not foveolate, well defined; mesepisternum irregularly wrinkled dorsally with smooth, polished area ventrally; propodeum with the lateral-basal area finely granular, the lateral-dorsal carinae complete, with two diverging carinae dorsally which become obsolete laterally and posteriorly; the posterior face and dorsal surface between the diverging carinae irregularly wrinkled and with an indistinct median carina basally; first tergite sharply carinate laterally, longitudinally striate with the striae slightly irregular medianly; second tergite striato-granular; the base of the third and fourth tergites finely striate; ovipositor one-third as long as the abdomen; first intercubitus obsolescent; stigma angulate at the middle where the radius leaves it. Dark ferruginous; antennae, propodeum and first tergite piceous; wings hyaline, strongly iridescent; venation pale brown.

Male.—Length, 2.5 mm. Dorsal part of the head more feebly sculptured than the female; base of the fourth tergite feebly striate; the diverging carinae of the propodeum shorter than in the female and the median carina better defined; the posterior face of the propodeum more distinctly reticulate; antenna 31-jointed.

Type locality.—Ithaca, New York.

Described from three females (one type) and three males (one allotype) recorded under Cornell University Experiment Station No. 1035. The type and allotype reared March 21, 1924; all other paratypes reared February 20, 1924, by D. T. Ries. Mr. Ries in transmitting this material states that the species is a parasite of *Cephus pygmaeus.*

Type, allotype and paratypes.—Cat. no. 27241, U. S. N. M. Paratypes, male and female, returned to Cornell University.

The number of antennal joints varies; as one of the female paratypes has twenty-nine joints in the antenna, and one of the male paratypes has only 26 antennal joints.

This species is apparently most closely allied to *chittendenii* (Ashmead) and *koebelei* (Riley). In Ashmead's key to the species of this genus it agrees better with *chittendenii* than with *koebelei*. It may be separated from *chittendenii* by the absence of the lateral carinae on the posterior face of the propodeum and the presence of striae on the base of the third and fourth tergites. From *koebelei* it may be separated by the longer antennae, the different arrangement of the carinae on the propodeum and the shape of the first tergite.

Since the above description was prepared Mr. Ries has forwarded five small males (which are not considered types), under Bureau of Entomology number Webster 18707, which are much darker than the types. These specimens are piceous, with most of the head and thorax above almost black. The number of joints in the antenna varies from 24 to 26. These small males were reared in the autumn of 1924 and come from the following localities in New York: Byron (Cage No. 4083), East Bethany (Cage No. 4084), Sodus (Cage No. 4109) and Neufield (Cage No. 4058).

Heterospilus etiellae, new species

Female.—Length, 2.5 mm. Length of ovipositor, 1 mm. Head, seen from above with the orbits gently receding; posterior orbits about half the width of the eye; face finely granular; frons to the level of the anterior ocellus granular; vertex with transverse wrinkles on a granular surface; posterior orbits shining below, dorsally sculptured like the vertex but not so strongly; antenna 24-jointed, the third and fourth joints subequal; scutum coarsely granular; notauli distinctly foveolate anteriorly; posterior portion of the prescutum reticulate; suture in front of the scutellum with three longitudinal rugae; disc of the scutellum laminate; dorsal aspect of the propodeum granulato-reticulate, the posterior face of the propodeum reticulate; dorsal aspect of the propodeum with a median longitudinal carina which joins the pentagonal area of the posterior face; mesepisternum smooth except medianly, where it is finely laminate; first tergite shorter than the second, striato-punctate with the striations predominating; second tergite with three transverse depressions, the first line-like, the two following broad, shallow, the surface longitudinally rugulose; third and following tergites smooth; ovipositor half the length of the abdomen; first and second abscissae of the radius subequal; recurrent vein interstitial. Ferruginous; dorsal aspect of the propodeum, base of the first tergite piceous; palpi, mouth parts and legs testaceous; flagellum black; wings hyaline; venation pale brown; parastigma dark brown, very sparsely clothed with glistening white hairs.

Paratype females show very little variation. The dark color of the propodeum extends on the side in some and the antennae vary from 22 to 24 joints.

Male.—Length, 2 mm. Antenna 23-jointed. The above description

of the female applies equally well to the male. The pseudostigma in the hind wing is large and unusually well developed.

Paratype male is rufo-piceous, but the dark areas can be distinguished by their black color; otherwise it agrees with the allotype.

Type locality.—Porto Rico.

Described from 19 females (one type) and two males (one allotype) reared from the larva of *Etiella zinckenella* Treitscke in the pods of chick pea intercepted at quarantine in New York City. Material collected by Ivan Shiller June 18, 1923, and recorded under New York No. 1912.

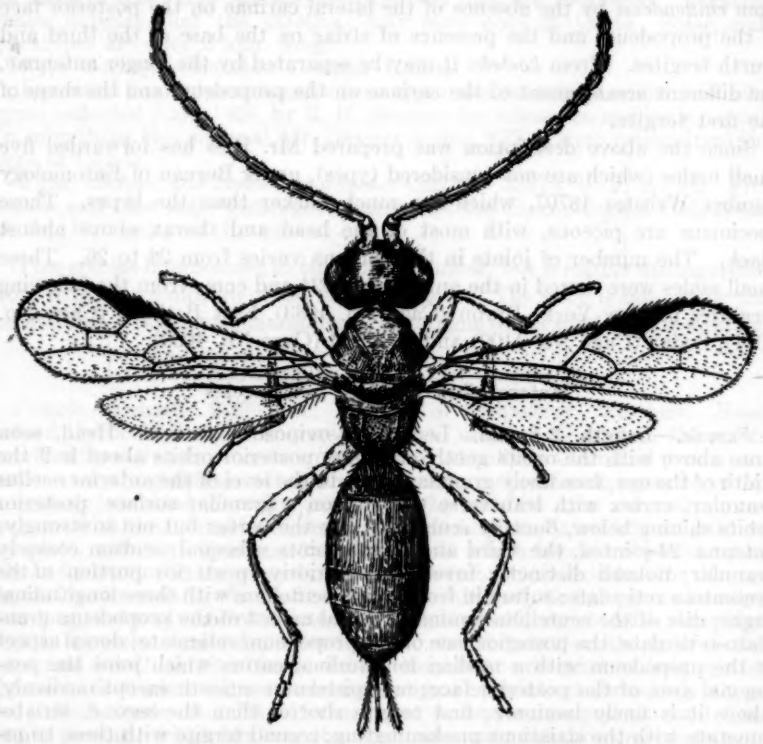

Fig. 1.—*Heterospilus zeteki*, new species. Adult female. (Drawn by E. T. Armstrong.)

Type.—Cat. no. 26599, U. S. N. M.

This new form is more like *Heterospilus longicaudis* Ashmead than any other species from the West Indies. It may readily be separated from *longicaudis* by the shorter ovipositor and by the presence of ridges on the propodeum.

Heterospilus zeteki, new species (Fig. 1)

Female.—Length, 1.5 mm.; length of ovipositor, 0.33 mm. Head when seen from above strongly narrowing behind the eyes; width of the posterior

orbits subequal with the width of the eyes; face coriaceous; frons, vertex, and orbits smooth and polished; antenna 16-jointed, the joints long and nearly of uniform length, third and fourth subequal; scutum polished; notauli simple; depressed area on the posterior portion of the prescutum irregularly wrinkled; suture in front of the scutellum finely granular at the bottom; propodeum reticulate, without a carina, the lateral-basal areas granular; mesepisternum polished; first tergite raised medianly, without predominating striae, the surface with longitudinal striae which are better defined immediately latrad of the raised area; second and following tergites smooth, polished; ovipositor about one-third the length of the abdomen; first and second abscissae of the radius subequal; recurrent vein nearly interstitial. Dark piceous; scape, four anterior legs, except the femora dorsally, the posterior tibiae and tarsi, posterior femora beneath, and the posterior trochanters testaceous; mouth parts and inner orbits rufopiceous thorax with sparse, long gray hairs; wings hyaline; venation dark brown.

Paratype female differs from the type in having the narrow base of the second tergite finely striated.

Male.—Length, 1.25 mm. Antenna 17-jointed. Agrees with the description of the female except the base of the propodeum is not reticulate, the sculpture of the face is not so coarse, and the head between the eyes at the level of the antennae is rufo-piceous.

Paratype male has the antenna 15-jointed, otherwise agrees with the allotype.

Type locality.—Barro Colorado Island, Canal Zone, Panama.

Described from two females (one type) and two males (one allotype) collected August 22, 1923, from the nest of *Nasutitermes ephratae* Holmgren. Material collected by J. Zetek and forwarded to T. E. Snyder under Zetek No. 2210.

Type.—Cat. no. 26598, U. S. N. M.

In the smooth sculpture of the thorax and abdomen this species is rather unusual, and may easily be distinguished from the other Neotropical forms by these characters and its general dark color.

Heterospilus melanocephalus, new species

Female.—Length, 2 mm. Length of ovipositor beyond end of abdomen, 0.75 mm. Head subquadrate, temples broad; face rather coarsely coriaceous; frons shining, indistinctly tessellate medianly; vertex with irregular, transverse aciculation immediately above the ocelli; antennae 20-jointed, the joints long and well defined, third joint slightly longer than the fourth; scutum granular, subopaque; notauli feeble; suture in front of scutellum with a few well defined rugae; propodeum sub-shining, areola large, reticulate; basal-lateral areas finely punctate; mesepisternum smooth, polished except the upper anterior angle which is coriaceous; sternauli well defined, coriaceous; sides of the propodeum reticulate; first intercubitus obsolete except for a small stump at the radius; radius leaving stigma beyond the middle, its first abscissa two-thirds the length of the second; abdomen short, apical width of the first tergite much greater than its length; first and base of second tergite longitudinally striate; first tergite has two predominating striae which form a raised wedged-shaped area medianly; second tergite without impressed lines; apex of second and all of the following tergites polished; ovopositor two-thirds of length of abdomen. Testaceous; head

black; scape and basal half of flagellum ferruginous, rest of flagellum piceous; wings hyaline iridescent; venation pale brown.

One of the paratypes has the antennae 18-jointed, and the transverse aciculation on the vertex are very feeble.

Type locality.—Uvalde, Texas.

Described from four females reared in June, 1921, by J. C. Hamlin, and thought by him to be a parasite of *Melitaria junctolineella*, and from one specimen from the same locality which Mr. Hamlin thought was a parasite of *Cornifrons elautalis*.

Type and three paratypes.—Cat. no. 25624, U. S. N. M. Single paratype returned to the collector.

Runs in Ashmead's key[1] to *hylotrupidis* Ashmead; but it differs in the black head, shorter first tergite, etc.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

THE GEOLOGICAL SOCIETY

395th MEETING

The 395th meeting of the Geological Society was held at the Cosmos Club November 12, 1924, President WRIGHT presiding and 89 persons present. The secretary announced the resignations of ADOLPH KNOPF and ESPER S. LARSEN and the death of THOMAS L. WATSON, State Geologist of Virginia, a corresponding member. The secretary also announced the result of a letter ballot on the place of meeting for the society as follows: Cosmos Club, 73; Interior Building, 14; No choice, 3.

Program: G. R. MANSFIELD: *Physiography of southeastern Idaho.* In southeastern Idaho the highest ridgetops at elevations of about 9,000 feet probably represent remnants of a peneplain developed in a region of complexly folded and faulted sedimentary rocks. The peneplain was dissected, and after the excavation of broad and deep valleys which, with the lower neighboring uplands, were extensively aggraded, the region was uplifted, and again subjected to erosion through several succeeding partial cycles. About 1,000 feet below the peneplain stand remnants of a late mature erosion surface, about which unreduced remnants of the earlier dissected peneplain or of an intervening erosion surface now rise in some places as high as 500 feet. Two later erosion surfaces stand at altitudes respectively about 300 and 600 feet lower. These form more or less well defined rock terraces above the present early mature canyons, which themselves range in depth from a few hundred to 1,000 feet or more. Older valleys, representing some of these earlier erosion surfaces, now hang here and there 400 feet or more above the present valley bottoms.

Some of the broader valleys or intermont basins have been reexcavated in the buried valleys, which succeeded the peneplain. Others are in part of structural origin or have been eroded in rocks with favorable structures. Still other valleys owe their transverse courses to superposition, succeeding the aggradational cycle which came after the peneplain. All have been aggraded to a greater or less extent, partly because of former arid climatic conditions and partly because of obstruction by basaltic flows in the lower

[1] Can. Ent. 25: 74. 1893.

valleys. Moister climatic conditions, probably associated with the latest glacial epoch, quickened the streams, notably Bear River, which rises in the glaciated Uinta Mountains, and permitted the youthful dissection of the aggraded material with the development of canyoned courses and graded reaches in some of the streams. Bear Lake, which occupies a reexcavated valley of structural origin in the southwestern part of the region, was developed to nearly twice its present size. Its highest level, maintained by alluvial fans, did not long persist, but superposition of its outlet upon buried ledges preserved the level of the lake long enough to develop shore lines, which may now be recognized at many places. Since glacial time little erosion has been accomplished. (*Author's abstract.*)

The paper was discussed by Messrs. ALDEN and MATTHES.

WILLIS T. LEE: *The caverns of Carlsbad, New Mexico.* This was an informal account of Dr. Lee's explorations, and was illustrated by lantern slides and moving pictures. It was discussed by Col. JOHN MILLIS, VERNON BAILEY, and E. F. BURCHARD.

396TH MEETING

The 396th meeting was held at the Cosmos Club November 26, 1924, with President WRIGHT in the chair, and 38 persons present. The secretary announced the death of ALFRED H. BROOKS, past president and an active member of the Society. He also announced the election to active membership of M. N. SHORT, FREDERICK WALKER, LLOYD GIBSON, and A. W. LAWSON

Program: Dr. KURT EHRENBERG, of the University of Vienna (by invitation): *Present day paleontologic work in Austria.* In Austria, as elsewhere, fossils were studied first as aids to stratigraphy. Invertebrates, particularly ammonites and gastropods, were of greater interest because of their abundance. Edward Suess, Mojsisovics, Hoernes, Neumayr, and many others worked chiefly on one or both of these groups.

In Neumayr's time, as a consequence of Darwin's and Haeckel's studies, the morphology and phylogeny of fossils became subjects of research, and vertebrates assumed greater importance. From the study of vertebrates started a new line of investigation, Paleobiology, which, begun by Dollo in Brussels, developed at Vienna almost into a new science. At the University of Vienna there is now a Department of Paleontology, under the leadership of Prof. C. Diener and Prof. G. von Arthaber, with collections arranged stratigraphically, and a Department of Paleobiology where Prof. Abel, the founder of Paleobiology, and his colleagues are working.

The paleobiologist endeavors to learn the mode of life of the fossil animal. Starting from the knowledge that the outward form of every organism depends to a large degree upon its mode of life, his first investigation is always towards the special adaptations to the mode of locomotion, environment, and food. All tracks left by the animals are of importance not only to such investigations but also to phylogenetic researches, because the above-mentioned adaptations are usually developed more or less gradually. Under favorable conditions the paleobiologist is able to finish his work with a restoration of the life of any past period as complete as the fossil documents with which he had to work. An illustration of this is to be found in the extraordinary results attained in the recent exploration of the "Drachenhöhle bei Mixnitz in Stiermark."

Latterly, paleobiological methods have been adopted in the study of invertebrates, but much remains to be done. Although the collections of the Department of Paleobiology of the University of Vienna contain a considera-

ble number of invertebrates, which of course are arranged in paleobiological order, they are insufficient for the study of all the groups of invertebrates. The speaker appreciated therefore, the invitation of the International Education Board of New York which enabled him to study the ample collections in some of the museums in the United States. (*Author's abstract.*)

Dr. Ehrenberg's paper was discussed by Messrs. BASSLER, HAGUE, and WRIGHT.

C. WYTHE COOKE: *Coastal terraces of Georgia.* Five coastal terraces corresponding to ancient shore lines now standing at altitudes of 60, 100, 160, 215, and 260 feet above sea level extend inland across the southeastern quarter of the state of Georgia. The two lower shore lines run parallel to the present coast of the Atlantic Ocean; the higher shore lines indicate former direct connection of the Atlantic with the Gulf of Mexico, Florida having been submerged. Emergence has been by stages separated by periods of quiescence; oscillation of sea level has been within narrower limits than north of Cape Hatteras.

When the sea retreated from the 215 to the 160-foot level, a group of islands appeared above water on the Floridian platform. From one of the islands a sand spit and submerged bar (the present Trail Ridge) extended northward to the vicinity of Jessup, Georgia, and shut off from the open ocean a sound similar in general appearance to Pamlico Sound of North Carolina. Further emergence permitted the water in the sound to drain southwestward into the Gulf of Mexico, giving birth to Suwannee River. Okefenokee Swamp, now 120 feet above sea level, occupies a depression in the floor of this ancient sound. (*Author's abstract.*)

This paper was discussed by Messrs. BASSLER, ALDEN, SAMPSON, WOODRING, HAY, W. C. MANSFIELD, HAGUE, BRYAN, and CAPPS.

397TH MEETING

The 397th meeting was held at the Cosmos Club December 10, 1924, President WRIGHT presiding and 51 persons present. The secretary announced the election of JOHN C. BEAM, U. S. Geological Survey, to active membership.

F. E. WRIGHT: *Methods for relative gravity measurements.* (Presidential address.)

After a brief recess the 32d Annual Meeting was called to order.

32D ANNUAL MEETING

The 32d annual meeting was held at the Cosmos Club December 10, 1924, with President WRIGHT in the chair, and 35 members present.

The minutes of the 31st Annual Meeting and the annual report of the secretaries were read and approved. The annual report of the Treasurer was presented, showing an excess of assets over liabilities of $1083. The following officers were elected for the ensuing year:

President, L. W. STEPHENSON; *Vice-Presidents*, D. F. HEWETT and CHARLES BUTTS; *Treasurer*, J. B. REESIDE, JR.; *Secretaries*, EDWARD SAMPSON and J. D. SEARS; *Members-at-large of the Council*, C. N. FENNER, F. E. MATTHES, F. H. MOFFIT, C. S. ROSS, R. B. SOSMAN; *Nominee for Vice-President of the Academy*, F. E. WRIGHT.

C. WYTHE COOKE, EDWARD SAMPSON, *Secretaries.*

SCIENTIFIC NOTES AND NEWS

The Petrologists' Club met at the home of H. G. Ferguson on February 17. Program: E. V. SHANNON: *Pegmatites of eastern Connecticut;* C. S. ROSS: *Petrology of an ore vein;* W. F. FOSHAG: *Andalusite deposits of the White Mountains, California.*

At a meeting of the Pick and Hammer Club at the Geological Survey February 21 informal accounts of exploration in Alaska during the past season were given by Messrs. P. S. SMITH, FORAN, and MERTIE.

W. M. BRAMLETTE is on leave from the Geological Survey to make investigations for an oil company in Ecuador.

Colonel THOMAS L. CASEY, who died recently, bequeathed his large collections of insects, mollusks, and fossils to the National Museum.

Professor F. W. CLARKE, of the Geological Survey, retired from the federal service the first of the year.

LAURENCE LAFORGE, of the Geological Survey, is giving a course of lectures in geology at Harvard University.

O. E. MEINZER, Chief of the Water Resources Branch of the Geological Survey, recently examined a reservoir site near Guantanamo, Cuba, for a public utility company.

A. F. MELCHER, geophysicist, has resigned from the Geological Survey to accept a position with the Marland Refining Company, at Ponca City, Oklahoma.

Dr. H. S. WASHINGTON, of the Geophysical Laboratory, Carnegie Institution of Washington, sailed for Europe early in February to carry on archeological and volcanological studies in Italy and northern Africa.

Dr. M. L. Crossley, president of the American Institute of Chemists, addressed the Washington chapter at its March meeting on the subject *Chemistry as a Profession.* Before the meeting, resident fellows of the Institute tendered Dr. Crossley a dinner at the Raleigh Hotel.

W. T. Foran, geologist in the Geological Survey who has been engaged for two field seasons in the exploration of Alaskan petroleum reserves, has resigned to undertake exploration work in Argentina.

Dr. ALEXANDER WETMORE, Superintendent of the National Zoological Park, was appointed on April 1 an Assistant Secretary of the Smithsonian Institution with general supervision of the National Museum, the National Gallery of Art, and the National Zoological Park.

The National Geographic Society has announced a grant of $55,000 to Dr. C. G. Abbot, to promote the establishment of a new solar radiation

station at a site to be chosen by Dr. Abbot in Africa or Asia, and to maintain daily measurements there for several years. The project is termed "The National Geographic Society's Solar Radiation Expedition, Cooperating with the Smithsonian Institution."

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